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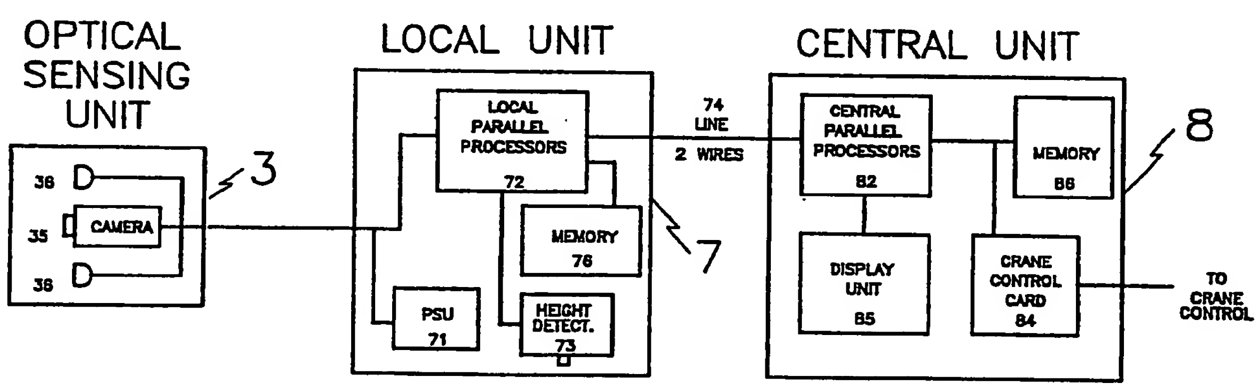

(57) Abstract

The present invention relates to an optical/visual sensing and controlling system for accurate positioning of a lifting device, especially a hoisting rig or/and a crane for handling of containers within a container stack yard. The invention provides a position sensing system for the hoisting rig of a loading and unloading crane, which may be integrated with further controls within the machine, but is also possible to install as a separate unit in an already present fixed or movable crane, to identify the position of the hoisting rig in relation to the locking hole(s) in a container to be hoisted. The invention further includes a set of corresponding optical sensors arranged at the front and the rear of the machine to facilitate that the crane maintains a track and course without introducing skewing or position offsets in relation to colored lines painted on the surface of the container stack yard.

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OPTICAL SENSING AND CONTROL SYSTEM .

This invention relates to an optical/visual sensing and control system for accurate positioning of a stacker crane, especially a hoisting rig or/and a crane for handling of containers within a container stack yard.

Prior art

Larger container terminals around the world are aiming for an increasing automatization of the container handling. One critical step in this automatization is the positioning of the hoisting rig over a container by the crane. Track bound cranes may be positioned relatively exactly on the tracks - within 25-50 mm - but many other factors like wind, stretching of the crane wire, oscillations etc. have as a result that an exact positioning of the hoisting rig hanging from the crane is quite intricate. Today this is done entirely manual by the crane operator and is completely relying on his experience and judgement.

Many container terminals today, besides the so called Straddle Carriers, as well use huge cranes which are not driven on fixed tracks but are freely moving machines on big rubber tyres also called R.T.G. (Rubber Tyred Gantry). The existing systems today for automatic/semiautomatic control are formed most often either by means of induction loops or by some kind of sensed tags. One example of an induction loop is disclosed in e.g. the document EP-A-0 098 896 by Sumitomo Electric Industries. An induction loop as such is operating, but many docks or loading and unloading yards do not permit induction cables to be dug into the ground. For track bound technique are disclosed also different optical code readers in e.g. SU 1194-750-A and SU-907-564. Mechanical gyro systems are cumbersome and need a long period of time for stabilizing and have not been shown in this kind of application in mind here and are probably not fulfilling the demands set up for control, e.g., of equipment for container handling.

Further some other different systems have been tried for the determination of position of large freely moving machines for

handling of goods. These systems include techniques having decoders against the wheels of the vehicle which will not provide enough accuracy. Additionally have been tested contact rollers towards the ground surface which commonly give the proper accuracy but those demand that the ground surface is absolutely free from litter or small stones etc. A third system depends on discrete readable tags spread out in the yard area and which will be read by the machine when it passes such a tag whereby its position will be recognized. A large number of such systems are known from trackbound technique. One example of such a system is disclosed in the patent document GB 2 112 982 by Mitsui Engineering and Shipbuilding Co. Ltd. (Japan) applied to a type RTG container crane. In the patent document DE 38 25 097 by Lanfer and Kugler, Germany is disclosed a device for positioning measurements applied to booms using color markings on the boom read by a simple optical sensor. Another system for identifying a container placed in a large stack served by a RTG is disclosed in the document GB 2 221 212 by Davy Morris Limited, Loughborough, UK. This system uses a computer for the identification of and storing how the different containers are located or were placed in the stack of containers.

For an effective handling of containers a system is needed which permits the vehicle to relatively freely move within a defined yard to handle the goods and that the system at a certain situation when loading more or less automatically may identify the position of the spreader relative to the container to be hoisted. Such a system for spreaders is published in the International Patent Document WO-A1-90/09336 by Bromma Conquip AB. Another system disclosed in the American Document US 4 139 107 is using a detector plate on the container which is detected for positioning of the spreader. Up to now no complete system for the control of these machines handling containers is not known.

Closed TV-circuits are applied to cranes e.g. in the Patent Document DT 26 42 373 showing the use of a video camera attached to a lifting crane. The problem with a crane handling containers

is that the feeding of a direct video signal through a simple coaxial cable is difficult due to the mechanical stress such a cable would experience as such a connection has to be made through the crane wire to the hoisting rig where the camera must be positioned. Optical sensing systems having for example a video camera are as such also known from surveillance systems with one or more cameras fixedly mounted for surveillance of one or more surveillance sectors. Additionally there are such systems working with a certain set of standard pictures to be able to judge whether an intruder is present within a given area of surveillance. However this type of pure surveillance does not have to operate as fast as compared to a corresponding system in a moving application, which directly or indirectly controls the motion, and accordingly from this reason these known surveillance systems are not suitable for solving the aforementioned problems.

Description of the invention

The present invention provides a positioning sensing system for the hoisting rig of a loading crane, especially a machine handling containers. The system may normally be integrated with other computerized processing and automatics within the machine but it may also be installed as a separate unit in an already existing fixed or transportable hoisting crane to identify the position of the spreader relative to the container being hoisted.

The system for identification of the position of the spreader comprises one or more optical sensors, in a preferred embodiment constituting a standard resolving video camera using a CCD cell, a light source, and a microprocessor based interface which senses, converts and evaluates the signals from the optical sensor and compares obtained data with previously stored standard data for judgement of the position of the spreader relative to the standard corner box of a container.

The present invention further provides an arrangement for urging a goods handling machine to follow a system of colored lines painted on the surface of the container stack yard. The system ensures by means of one or more optical sensors attached to the machine that it maintains a path and direction without introducing skew or position deviation relative to the colored lines painted on the surface of the yard.

The system in accordance to the present invention includes along with one or more optical sensors also lighting units attached to the goods handling machine for tracking of the colored lines on the yard surface, a data processing unit with an associated control and display device and a control unit arranged in the cabin of the machine to manually or semiautomatically move the machine in accordance with the colored lines on the surface of the yard. The colored line system on the surface yard also through incorporation of an encoding system provides that absolute positioning information will at every instant be obtained by the data processing unit within the machine.

The system for identification of the position of the hoisting rig further provides the following advantages:

A) the system only needs limited guidance arms eventually protruding at any side of a container,
B) the system even functions when the containers are stacked so that they are close together,
C) the system functions for all containers having standard corner boxes independent if those are lacking roof or sides,
D) the system functions for direct control of the crane as it gives exact information of distance and direction to the standard corner box, whereby offsets in the x- and y-direction are given in absolute measure, especially in mm,
E) the crane control and the operator do get during the lowering of the spreader continual information of the position of the spreader relative to the underlying container. Thereby corrections in x- and y-direction of the

spreader and the crane, respectively, are carried out during the lowering, which operation in principal does not have to be interrupted,

F) the system externally only demands small units for the optical sensing and lighting and a local processing unit, which easily may be positioned onto the hoisting rig,

G) the system functions in a height interval, which for the hoisting rig may vary between 0.1 and about 3 meters or even more,

H) the system provides the operator in a maneuvering cabin of the machine or, for a larger semiautomatic loading and unloading system, in a central control room also a kind of visual information of the position of the spreader relative to the container to be hoisted.

Brief description of the figures

The present invention will be described in several preferred embodiments to be read together with the enclosed drawings in which

Fig. 1 shows a spreader having an optical sensor comprising a video camera and an associated local processing unit including also a local electronic circuitry,

Fig. 2 shows a schematic block diagram for a control system of a spreader in a crane for handling of containers in accordance with the present invention,

Fig. 3 shows a preferred embodiment of an optical sensor comprising a CCD-type video camera in accordance with the invention,

Fig. 4 shows a preferred embodiment of a monitor for the control system with presentation of data regarding the position of the spreader and its motion illustrated on the screen,

Fig. 5 shows schematically in a preferred embodiment a portion of line markings on the surface of a container stack yard for control of a hoisting crane for containers in accordance with the present invention,

Fig. 6 shows a schematic block diagram of a control system of a hoisting crane for containers in accordance with the invention, and

Fig. 7 shows the same monitor display as in Fig. 3 but having a presentation of data when maneuvering the crane machine.

Preferred embodiments

When a hoisting crane for container handling, e.g. a gantry has placed itself in a preliminary desired position to hoist a container, a spreader will start to be lowered down. In Fig. 1 is shown a principle plane view from above of a standard type spreader 1 for containers and having its four guidance arms 2 in a raised position. The spreader is further provided with an optical sensor 3 in the form of a CCD type videocamera 35 having a lighting arrangement 36 (Fig. 3) arranged at a corner 4. In a first embodiment the video camera is provided with fixed focus optics. Additionally is arranged onto the spreader a first local processing unit 7 comprising an electronic device PCU 71 (Fig. 2) for conversion of picture data from the CCD camera into digital pattern data, which are input to a number of first parallel processors 72 and then transmitted through a communication path 74, e.g. an optical fiber, a cable system with a preferably two wire system or a directed radio link system, preferably in the Ghz region, transferring already partly processed and compressed information to a central processing unit 8. In Fig. 2 is shown a simplified block diagram of the optical sensing arrangement for positioning of the spreader. As may be seen from Fig. 2 there is also a height detection device 73 which continuously gives additional help information in form of a

height which partly in one embodiment of the present invention facilitates control of the focusing and the focal distance of the CCD camera 35 and partly for general information to the central processing unit 8 of the height of the spreader in relation to the highest surface of an underlaying subject, besides the information which the computer system is able derive from picture data using for example the size of one of the four locking holes present in the upper corner box surfaces of a container. Such a locking hole is for example according to ISO oval and has the standard measures 63 x 124 mm and the size of this locking hole in the picture generated by the camera is recorded by means of a processing unit. The height detector 73 gives the distance to the highest point of an object present within an area corresponding to slightly more than the area of the spreader by using well known measurement technique within the preferred embodiment constituting a small electronically connected ultrasonic measuring device, which however has a certain limit for containers lacking a roof, while the picture processing besides the position sideways primarily also gives the distance to just the locking hole of a localized corner box, which is recognized by the local processing unit 7 and/or by the central processing unit 8 by comparison of the size of the standard holes with stored standard data e.g. as a function of the depicturing height. During the lowering of the spreader the optical sensor 3 identifies the corner having the normally oval locking hole at the corner box of the container closest to the corner 4 and the sensor 3 of the spreader, and the central processing unit 8 gives semiautomatically/automatically via a crane control interface 84 corrections to the crane for smaller adjustment so that the hoisting rig will land exactly against the standard corner box of the container. As the processing unit continually receives information about the position of the spreader eventual necessary adjustment sideways in position will be done (or forward or backward with the machine itself during continuous lowering of the hoisting rig, which operations in principal does not have to stop the lowering motion for a minor correction of the position. As the optical sensor 3 only searches for the corner or the

locking hole at the upper frame of the standard corner box it makes no difference if the container is lacking roof or sides. The operator receives simultaneously picture information on a monitor 85 with a screen as shown in Fig. 4. Thus the operator can also observe the container in a kind of side view and the position of the locking arrangement of the spreader relative to the locking hole in a simplified line sketch and calculated coordinate deviations, which give a very exact feeling of how the hoisting rig is positioned, which in turn will result in that the whole process may further be executed faster, besides that it will be more safe. If the spreader should be lowered below the normal height of a standard container the operator will be alarmed by the central processing unit that an abnormal situation is present.

In Fig. 3 is shown in a preferred embodiment an optical sensor consisting of a CCD video camera 35 together with a lighting unit 36. The lighting unit 36 at the CCD video camera primarily operates in the preferred embodiment with continuous lighting, but in a second embodiment it is working with intermittent lighting in the form of flashes synchronized with the electronic device for conversion of the picture information from the CCD camera into digital pattern information for further processing by the data processors 72 in Fig. 2. The camera system 3, 35 always regularly operates with continuous light when no extra light is used or when also the extra lighting 36 is continuous dependent of the type of lighting device.

In a first embodiment a processing unit compares the obtained picture data with previously stored parameters according to prior art. In the second embodiment the central processing unit 8 instead operates in two modes, in part a mode of learning and in part an operation mode. The mode of learning is used to create pattern sets in the memory device for comparation with actual obtained patterns in the normal operating mode i.e. during positioning of the hoisting rig. In the mode of learning the hoisting rig is manually operated to different heights and

positions over the standard corner box of a container and the simplified patterns thus created via the processing unit 7, and primarily obtained from the optical sensor 3, are stored in the memory device 76 and partly in the memory device 86 of the central processing unit, which comprises write and read memories (RAM), by means of established technique using a preprepared program for the processors. Thus the obtained reference patterns are transferred by means of an electronic device (not shown) to ROM circuits which then are inserted into the memory devices 76, 86 and will according to established technique form part of the read memory in the memory devices 76, 86, from which different reference patterns can be obtained during the operating mode.

Thus processing unit 7 in the second embodiment operates to partly create standard corner box reference picture patterns of a container and besides similar to the first embodiment obtaining actual picture patterns during the positioning of the spreader to the standard corner box. The ROM circuits obtained according to the procedure above which contains digital pattern data are preferably primarily placed into the local processing unit 7 onto the spreader itself so that an essential part of the picture processing will be done locally by a digital processor or several primary parallel processors 72, which preferably are so called transputers, to as far as possible locally reduce the amount of data, essentially in the form of coordinate information, which is then transmitted to and received by the central processing unit 8 in a compressed form according to known technique via a communication path 74 formed by for example an optical fiber or an electrical two wire system or a directed radio link system. A conventional physical connection with even more than two wires is of course possible for an eventually higher rate of transmission, but a physical connection with as few wires as possible is the most proper when having in mind the stress which such a cable will experience. Thereby is also the possibility of incorrect transmission of information reduced to a large sense by the fact that an interruption of one of the two wires opposite to the use of many wires will result in that the transmission completely

will be interrupted as an indication that the cable has to be repaired or exchanged.

In Fig. 5 is illustrated a part of a larger line pattern in a preferred embodiment of the present invention painted with a color of preferably e. g. white, green, blue or red paint on the surface of the stack yard where a crane especially a machine handling containers is moving around. In Fig. 6 is demonstrated a corresponding schematic block diagram of the main parts in an arrangement for control of the crane itself. Fig. 6 demonstrates in the preferred embodiment two optical sensing units 3', 3", each with a CCD video camera 35', 35" and lighting units 36', 36" which in principle are identical to the optical sensing unit 3 shown in Fig. 3 and attached to the spreader. One camera unit 3' is here placed at the front of the crane while the other unit 3" is correspondingly placed at the rear of the crane. The arrangement shown in Fig. 6 further comprises an electronic device 71' for conversion of the picture signals into digital signals and a number of primary parallel processors 72' directly connected to the CCD video cameras via the electronic device 71' similar to the arrangement shown in Fig. 2. In a preferred embodiment for this application the processing unit 7' can of course be incorporated in the central processing unit 8, but from reasons of unitarity in this description the unit 7' is displayed as a separate unit. Additionally there is present similar to the previous picture the central processing unit 8 with the additional secondary parallel processors to which the primary parallel processors are connected over a data bus 74'. The central processing unit 8 processes the picture signals similarly to the previous description into the form of simplified picture patterns from the primary parallel processors 72' and partly shows the actual obtained measurement data on the monitor 85 (Fig. 7) and controls via a crane control interface 84 in Fig. 6 (not shown control means) the machine in its motion along the pattern of lines arranged within the container stack yard area.

In Fig. 5 a small portion of lines is visualized, in a preferred embodiment, along which the machine is maneuvered during transportation along a dock or in a loading and unloading area. Fig. 5 is showing a four way crossing of these tracking lines. If the crane is moving forward in the direction of the arrow 110 it is possible to choose between three possible track alternatives by means of a maneuvering unit (not shown) or by in advance inputting data to the central processing unit via a not shown keyboard. If the operator had chosen the command "left" the crane will follow the curved line 13, 31 and after that the line 30 and so on. If the operator instead had chosen the command "right", the crane follows the curved line 14, 41 and further the line 40 in the opposite direction of the arrow 140. If the operator finally would have chosen the command "straight forward" the crane will go via the line 12, 21 and further along the line 20 opposite the direction of the arrow 120. Correspondingly if the crane comes along the line 40 in the direction of the arrow 140 there are two possibilities of path alternatives by commands from the maneuvering unit or the not shown keyboard. Either is chosen a path to the left via the curved line 41, 14 and further along the line 10 opposite the direction of the arrow 110 or a path straight forward via the lines 43, 34 and further along the line 30. Accordingly there is here no possibility by following the system of lines to choose a path to the right and the crane cannot otherwise than fully manually be turned to the right as the optical sensors then will loose contact with the tracking line pattern and the central processing unit would not allow this during program controlled driving. From now on is therefore assumed computer controlled driving.

If the crane comes along the direction of the arrow 120 there is in this line crossing no alternative of choice but the crane has to proceed forward via the lines 21, 12 and further along the line 10 opposite the direction of the arrow 110. As is further shown by Fig. 5 there is always a short break in the line before a position where several alternative line paths are present to further ensure that the central processing unit 8 will catch the

change in the pattern along the path of motion. In a motion along the direction of the arrow 120 the interruption at 13, 14 indicates that alternative line paths join while in motion along the direction of the arrow 110 the interruption at 13, 14 indicates that alternative paths of motion are present. As the machine is provided with identical optical sensors in the front 3' and at the rear 3" the system will function in the same way independent if the machine is driven forward or backward. In reverse motion the rear optical sensor 3" is connected with its camera 35" as a primary sensor by the central processing unit 8 while during forward driving the forward optical sensor 3' with the camera 35' is the primary optical sensor.

Each line segment further comprises in a first embodiment binary encodings which is partly exemplified in Fig. 5. The central processing unit 8 reads the binary data of the simplified digital pattern received from any of the primary parallel processors 72'. In the first embodiment this is done by means of a synchronization mark which is longer than the other 8 marks in the embodiment in Fig. 5. These are placed on either side of the lines dependent whether they should indicate a logical "one" or a logical "zero". From the synchronization mark is the most significant bit MSB is given for the binary number facilitating that the patterns unambiguously can be read from both directions. In a second embodiment this binary word of data contains considerably more than 8 bits, preferably 16 bits and are found at numerous places along a segment of line why the central processing unit 8 by means of these will be able to decide a very exact position of the crane, partly by the position of the digital pattern information along the line, and partly by the time between each such read pattern information which also simultaneously gives information about the speed of the machine. In a third embodiment these binary pattern number are formed by a redundant bar code representing a number of binary bits by means of lines with different thicknesses. By in the preferred embodiment reading at both sides of the line also redundant information is achieved to further ensure correct reading. In

each position in the first and second embodiments the coding marks for logical "one" and logical "zero" can be found only on either side of the line excluding the longer synchronization marks why the binary number will be read twice, direct and reverse, whereby the actual processor controls that the two registrations correspond. If such a correspondence is not achieved the operator will be alerted, and he can check whether the painted colored line might have been damaged or a subject of the right color and right size and shape as a mark can be found or if some unqualified item is covering the line. In case of an eventual damage the line is simply adjusted by means of new color and by means of a templet according to well known technique. In the embodiment there is close to the CCD camera 35', 35" and its lighting arrangement 36', 36" an air pressure unit (not shown) blowing towards the area which is detected by the CCD camera. In this way small amounts of grit or snow is blown away from the line to obtain correct scanning of the line.

In a first embodiment a processor compares the picture data, achieved by a program, with previously stored parameters according to prior art. In the second embodiment the central processing unit 8 operates according to the previous description in two modes, one mode of learning and one operation mode. The learning mode is then used as previously described, to create pattern sets in the memory device 86 for comparison with actually obtained patterns during an action of motion. In the mode of learning the crane is manually driven to different types of crossings in the line network and simplified patterns derived by the optical sensors 3', 3" are stored in RAM similar to the previously mentioned example in connection to Fig. 2 by means of a preprepared program for the processors according to established technique. The reference patterns thus obtained are transferred by means of the electronic device (not shown) to ROM capsules which then are inserted into the memory device 76 or 86 alternatively, and will according to known procedure constitute a read memory from which the reference patterns are obtained during the operation mode which already has been described previously in

connection to the description of the positioning of the hoisting rig in the preferred embodiment.

In Fig. 7 is shown in a first and a second embodiment the monitor screen 85 connected to the central processing unit 8. By means of a picture according to Fig. 7 on the monitor screen 85 the operator receives actual information about the position of the crane relative to desired path of motion. The operator has a possibility to choose between manual maneuvering or semiautomatic maneuvering and additionally if measures should be given in metric unit i.e. m and cm or according to for example measures using foot and inches etc. The monitor screen also shows how the motion is planned to continue according to eventually already fed information to the central processing unit 8.

The way of operation of already wellknown parts in the processing units 7, 7' and 8 with the control functions and computer programs as well as a detailed way of function for the electronic devices 71, 71' have here been excluded as these parts do not constitute the invention but only constitutes parts to provide the solution of the total maneuvering problem which is the objective of the present invention. Characterizing marks of the invention is defined by the independent claims 1 and 2 and the associated dependent claims.

CLAIMS

1. An arrangement comprising optical sensors for sensing of the position of an object, for controlling for example loading and unloading of a container by a lifting crane, especially a type of crane provided with a hoisting rig (1) adapted to locking means in the container for hoisting and moving of the container to or from a specific position, additionally the arrangement comprises a variety of optical sensors (3, 3', 3"), a central processing unit (8) comprising a memory device (86) formed by ROM and RAM circuits, control means such as a keyboard and a maneuvering device, a monitor unit (85) forming a screen, whereby the data processing unit (8) is controlled by a computer program stored in the memory device (86), and additional maneuvering means for influencing the crane,

c h a r a c t e r i z e d in that

the variety of optical sensors (3, 3', 3'') are connected via an electronic device (71, 71') to a processing unit (7, 7') constituting a separate unit in contact with the processing unit (8) or integrated with the central processing unit (8),

the processing unit (7, 7') is comprising one processor or a multiplicity of digital processors (72, 72') and a memory device (76, 76') including local software and parameters for comparison with data recorded by an optical sensor and whereby the result of the comparison is processed by the processor/s (76, 76'),

the electronic device (71, 71') is converting instantaneous signals from the optical sensor (3, 3', 3'') into digitally represented signals input to the processing unit (7, 7') for processing and comparison with the parameters defined in the software stored in the memory device (76, 76') or (86),

the processing device (7, 7') and/or the processing device (8) is/are comparing instantaneously obtained data with previously stored parameters according to a predetermined program and based on the result of the comparison issuing signals for transmission to and acting on the maneuvering means to influence the object according to a predetermined manner.

2. An arrangement comprising optical sensors for sensing of the position of an object, for controlling for example loading and unloading of a container by a lifting crane, especially a type of crane provided with a hoisting rig (1) adapted to locking means in the container for hoisting and moving of the container to or from a specific position, additionally the arrangement comprises a variety of optical sensors (3, 3', 3"), a central processing unit (8) comprising a memory device (86) formed by ROM and RAM circuits, control means such as a keyboard and a maneuvering device, a monitor unit (85) forming a screen whereby the data processing unit (8) is controlled by a computer program stored in the memory device (86), and additional maneuvering means for influencing the crane,

c h a r a c t e r i z e d in

a local processing unit (7, 7') comprising a multiplicity of parallel processors (72, 72'), especially so called transputers, and a memory device (76, 76') comprising ROM and RAM circuits including local software,

that ROM circuits in the memory devices (76, 76', 86) besides the software are storing a multiplicity of patterns in the form of digital simplified pictures corresponding to different positions of the controlled object,

that the central processing unit (8) comprises one processor or a multiplicity of parallel working processors, especially so called transputers,

that an electronic device (71, 71') instantaneously converts obtained signals from the optical sensor (3, 3', 3") into digitally represented simplified patterns fed to the local processing unit (7, 7'),

that the local (7, 7') and the central (8) processing units are comparing the instantaneously obtained patterns with the different stored patterns according to a predetermined method and as a result of the comparison issuing signals for transmission to and influence of the maneuvering means to control the object according to a predetermined manner.

3. The arrangement according to claim 2, characterized in
that the central processing unit (8) additionally has two modes of operation of which a first mode of learning is used to in RAM circuits of the memory device store digital simplified patterns obtained from the local processing unit (7, 7') for later use, and that a second mode of operation is used to temporarily in the RAM circuits store the digital patterns obtained from any optical sensor (3, 3', 3") via the electronic device (71, 71'),
that the patterns transferred to and stored by the memory device (86) in the first mode of learning are readable to be transferred into ROM circuits,
that an electronic device is comprising an arrangement which, controlled by the central processing unit (8), is transferring digital pattern data from the memory device (86) into ROM circuits, which afterwards may be inserted into the memory devices (76, 86) as fixed read memories.

4. The arrangement according to claim 2 or 3, characterized in
that the RAM circuits in the memory device constitute a type which has multiple inputs/outputs and which allows storing in one memory position via one input/output simultaneously with reading of another memory position via another input/output by any of the microprocessors.
that the arrangement further comprises a lighting device (36) arranged together with the optical sensor (35),
that the optical sensor (35) constitute CCD type video cameras preferably pointing downwards.

5. The arrangement according to any of claim 1, 3 or 4, characterized in
that at least one optical sensor (35) is arranged at a corner (4) onto the hoisting rig (1) of a container crane,
that the arrangement further comprises a lighting unit (36) arranged together with the optical sensor (35),

that the arrangement further comprises a lighting device (36) arranged together with the optical sensor (35),

that the optical sensor (35) constitutes a CCD type video camera pointing downwards.

6. The arrangement according to claim 5, c h a r a c t e r - i z e d in

that a height detection device (73) is arranged onto the hoisting rig (1) and connected to the local processing unit (7) to obtain the distance to an underlying object.

7. The arrangement according to claim 6, c h a r a c t e r - i z e d in

that in the processing unit (7) is arranged in the proximity to the optical sensor/s (35) onto the hoisting rig (1).

8. The arrangement according to any of the preceding claims, c h a r a c t e r i z e d in

that the local processing unit (7) onto the hoisting rig besides the regular power feeding is arranged with a signal transferring device, which is connecting to the central data processing unit (8) in the crane, and continuously transferring already partly processed pattern data to the processing unit for control of the hoisting rig and the crane via a crane control interface (84) and for monitoring of actual data by the monitoring unit (85).

9. The arrangement according to claim 8, c h a r a c t e r - i z e d in

that the signal transferring device is a physical connection with several wires comprising an electric cable preferably with two wires or that the signal transferring device is a fiber optic cable.

10. The arrangement according to claim 9, c h a r a c t e r - i z e d in

that the signal transfer device is a radio frequency data communication, preferably in the form of a directed radio link operating in the Ghz range.

11. The arrangement according any of the preceding claims, c h a r a c t e r i z e d in

that optical sensors (35', 35'') are arranged onto the crane to sense colored lines painted on the surface where the crane including the arrangement of optical sensors is moved around,

that the arrangement further comprises lighting units (36,, 36'') arranged together with the optical sensors (35', 35''),

that the optical sensors (35', 35'') constitute CCD type video cameras pointing downwards,

that the colored lines together represent a larger pattern constituting a multiplicity of different motion paths for the crane.

12. The arrangement according to claim 11, c h a r a c t e r - i z e d in

that the colored lines additionally comprise binary encodings which are sensed by any of the optical sensors (3', 3") and that the signal is converted by the electronic device (71') and fed to a microprocessor in the local data processing unit (7'),

that the central processing unit (8) out of data obtained from the local processing unit (7') further decides which type of pattern which in every moment is present from the optical sensors (3', 3") whose output signals have been converted by the electronic device (71') into digital information.

that the data processing unit (8) by means of the binary encoding in the colored lines obtained via of any of the parallel processors (72') decides an actual position and the actual motion path of the crane.

13. The arrangement according to any of the preceding claims 11 - 12, c h a r a c t e r i z e d in

that the maneuvering means are sensitive to signals from the data processing unit (8),

that the data processing unit (8), in each moment guided from recognized patterns registered by the optical sensors (3', 3"), is supplying the maneuvering means with signals to ensure that the crane is moved according to the colored lines in accordance to a predetermined manner stored in the data processing unit (8) or input by its control means or the keyboard.

14. The arrangement according to claim 13, c h a r a c t e r - i z e d in

that in the vicinity of the CCD camera (35', 35") is arranged an air pressure generating device for blowing away smaller particles in the form of sand, grit or snow on the surface within the picturing area of the camera.

15. The arrangement according to any of the preceding claims, c h a r a c t e r i z e d in

that the lighting unit of the CCD camera is intermittent forming when working repeated light flashes synchronized with the electronic device (71') for conversion of picture information into digital pattern information.

HOISTING RIG

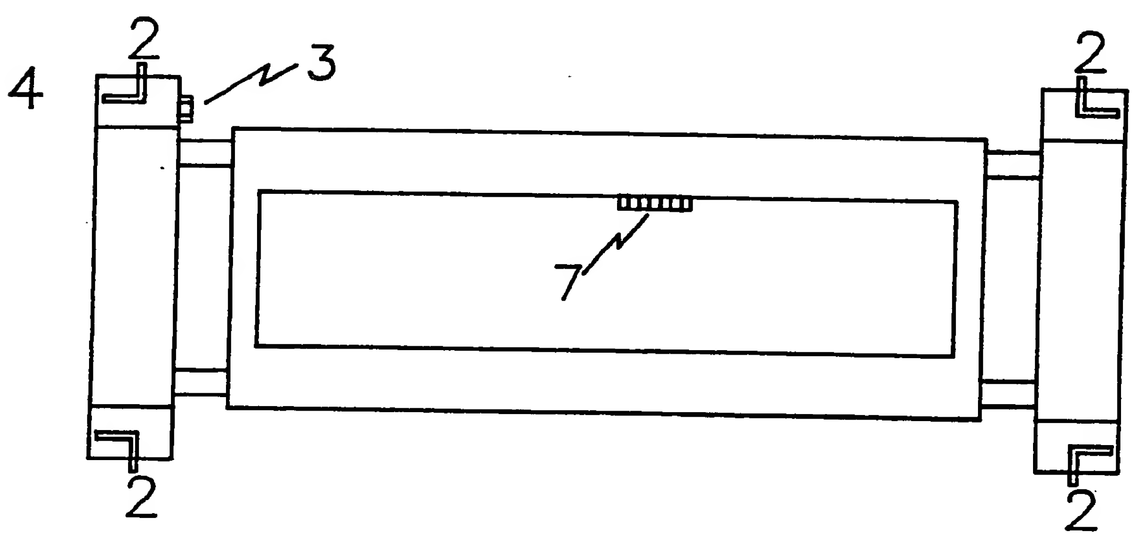

Fig. 1

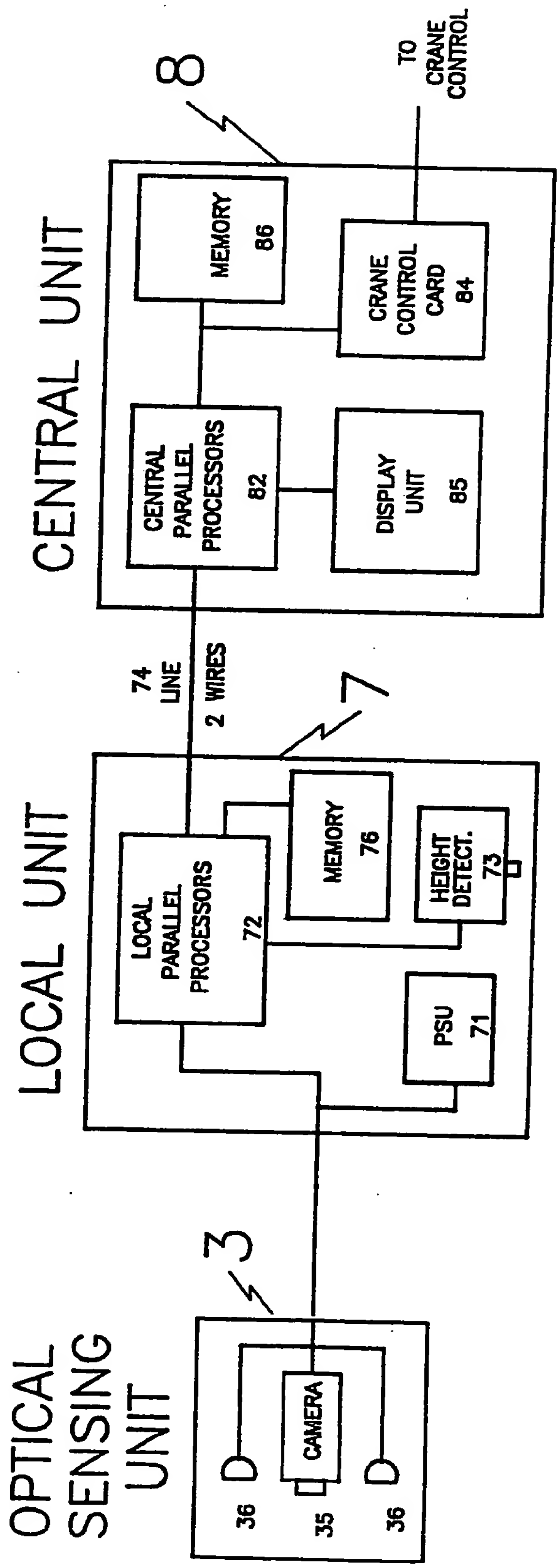
OPTICAL SENSING UNIT
3
CAMERA
35
36
36
LOCAL UNIT
7
LOCAL PARALLEL PROCESSORS 72
MEMORY 76
HEIGHT DETECT. 73
PSU 71
74 LINE
2 WIRES
CENTRAL UNIT
8
CENTRAL PARALLEL PROCESSORS 82
DISPLAY UNIT 85
MEMORY 86
CRANE CONTROL CARD 84
TO CRANE CONTROL

Fig. 2

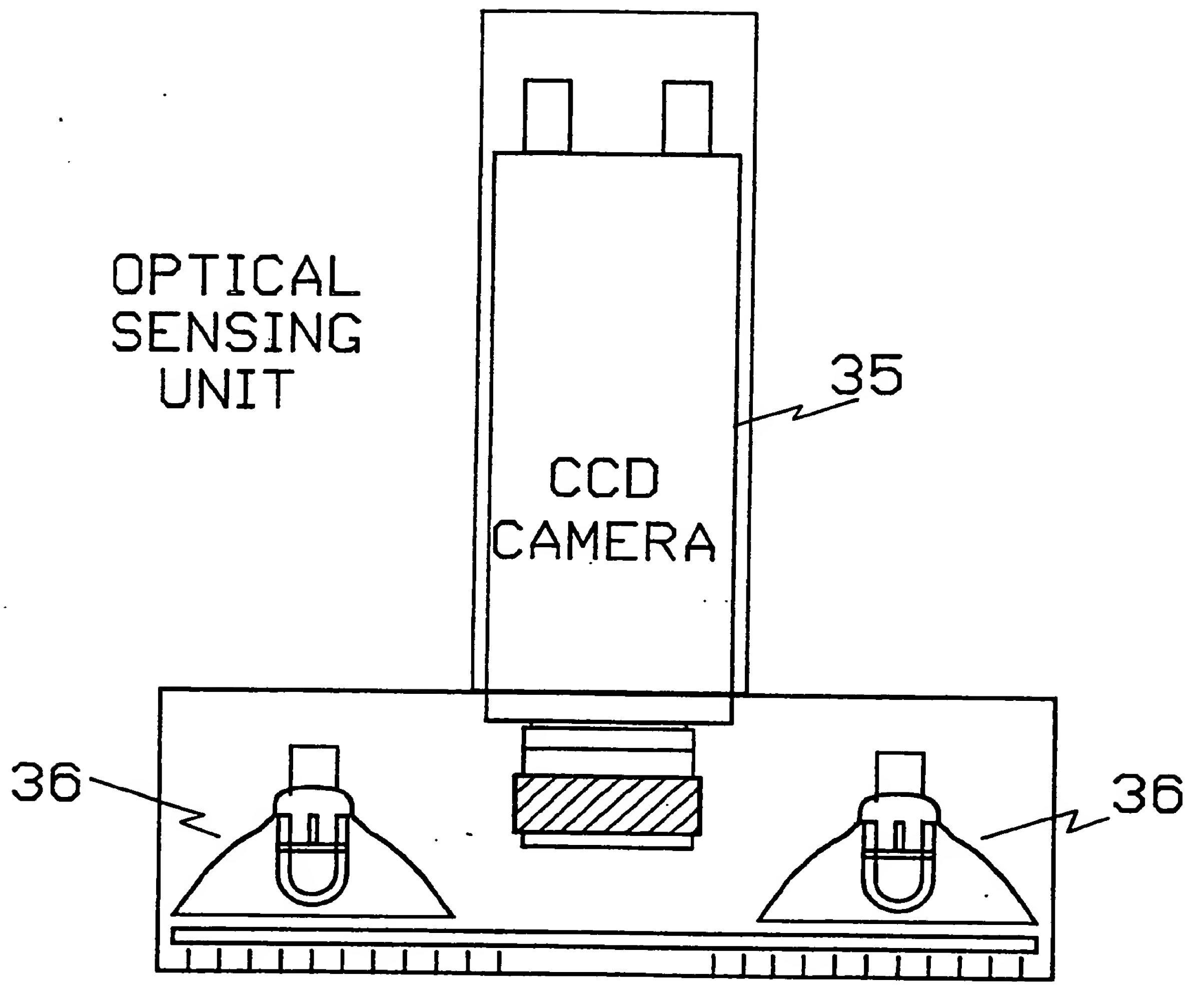

Fig. 3

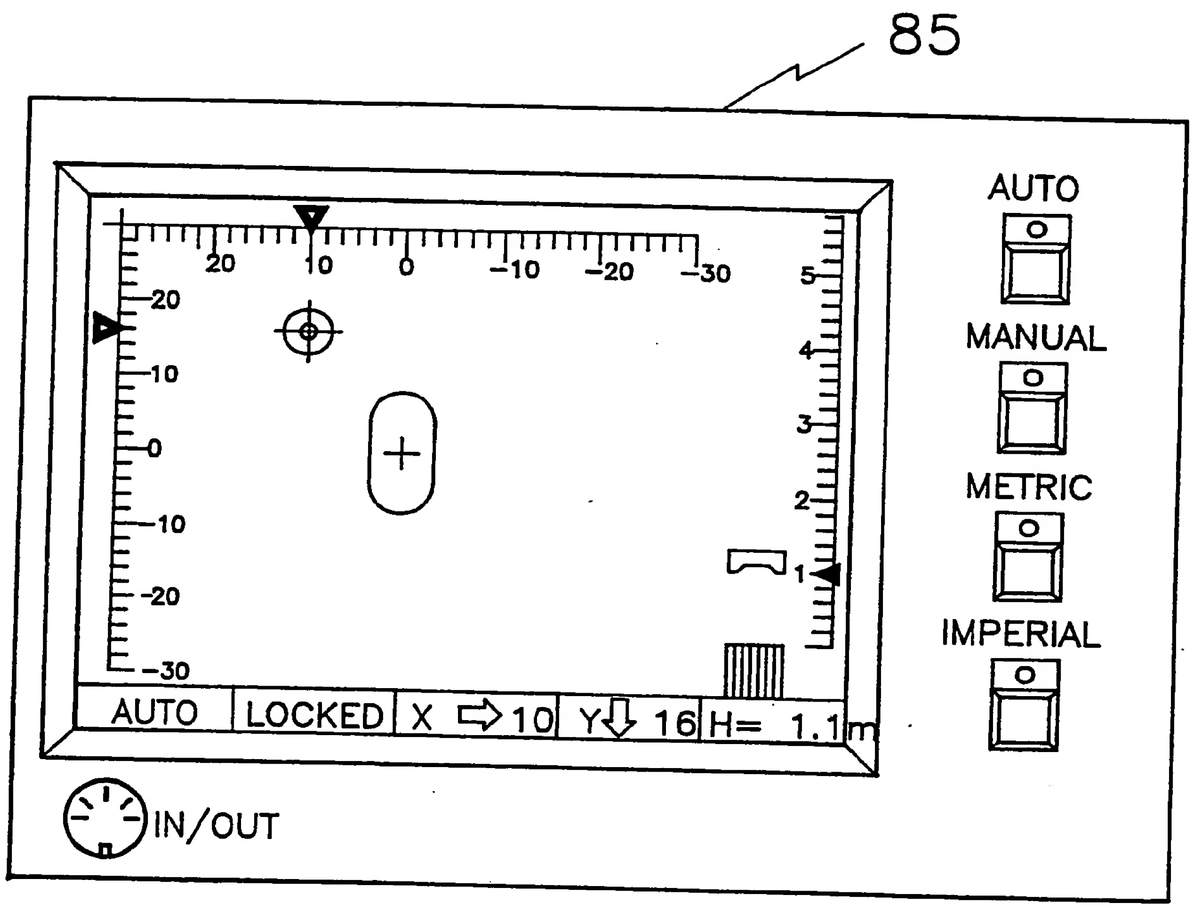
85
AUTO
MANUAL
METRIC
IMPERIAL
20
10
0
-10
-20
-30
5
4
3
2
1
AUTO
LOCKED
X ⇨10
Y⇩ 16
H= 1.1m
IN/OUT

Fig. 4

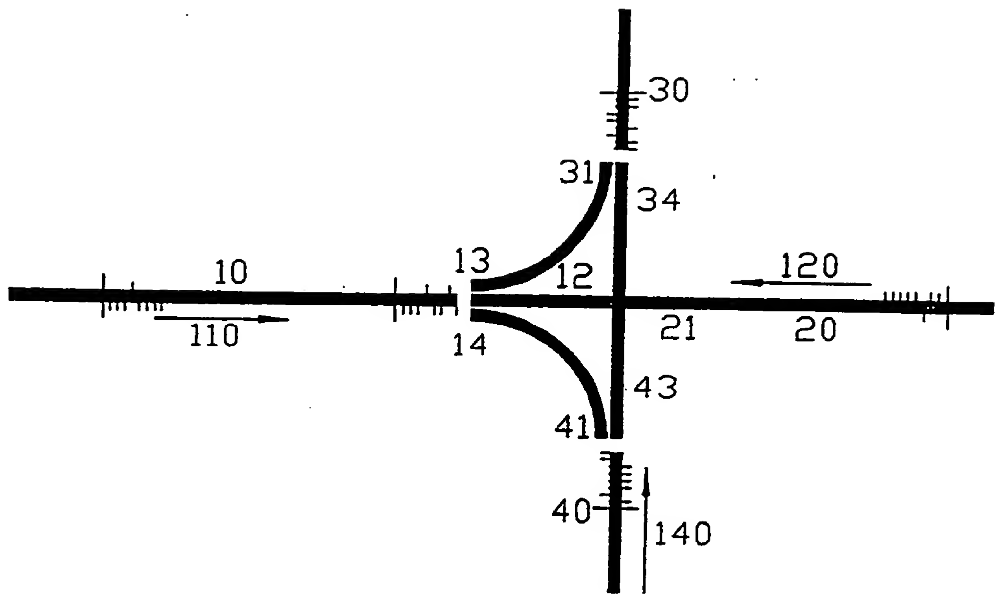

Fig. 5

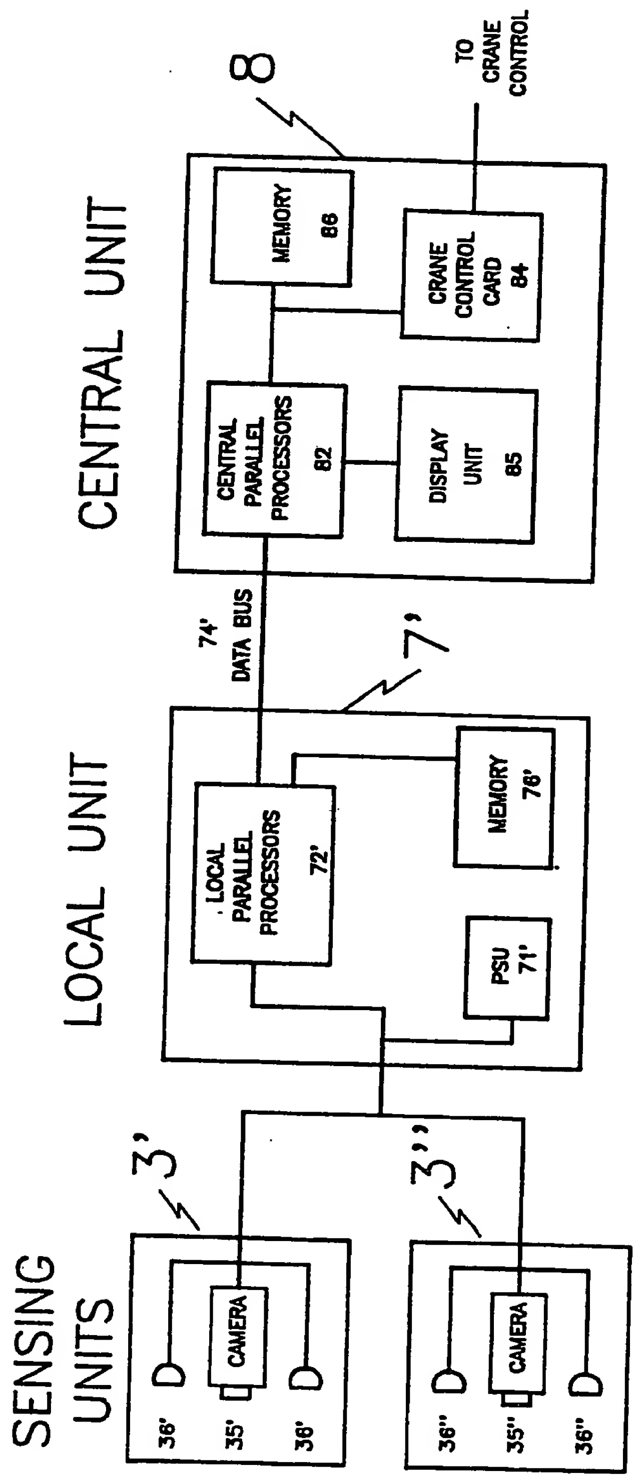
CENTRAL UNIT
8
TO CRANE CONTROL
MEMORY 86
CRANE CONTROL CARD 84
CENTRAL PARALLEL PROCESSORS 82
DISPLAY UNIT 85
74' DATA BUS
7'
LOCAL UNIT
LOCAL PARALLEL PROCESSORS 72'
MEMORY 76'
PSU 71'
SENSING UNITS
3'
3''
CAMERA
36'
35'
36'
CAMERA
36''
35''
36''

Fig. 6

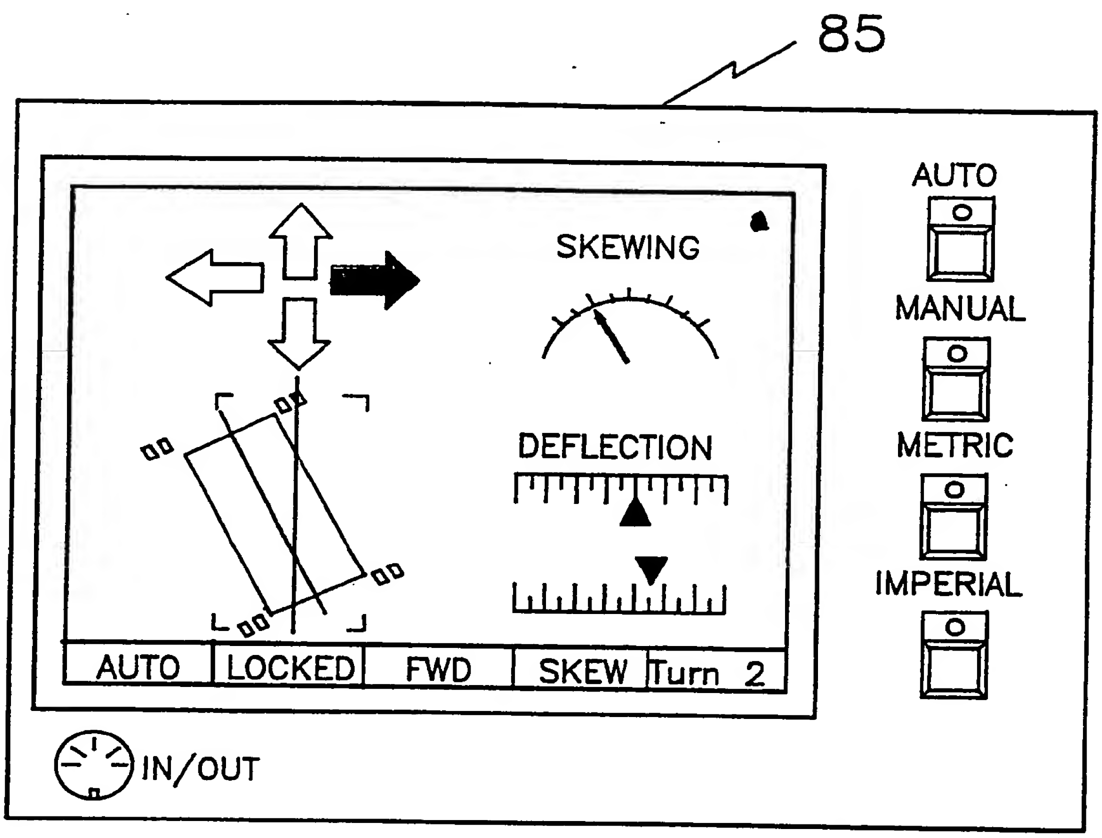
85
SKEWING
DEFLECTION
AUTO
MANUAL
METRIC
IMPERIAL
AUTO
LOCKED
FWD
SKEW
Turn 2
IN/OUT

Fig. 7

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 92/00284

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: B 66 C 13/46, 1/66

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	B 66 C

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
Y	EP, A2, 0342655 (TAX INGENIEURGESELLSCHAFT MBH) 23 November 1989, see column 4, line 54 - column 5, line 32; column 9, line 55 - line 58 --	1-15
Y	WO, A1, 9009336 (BROMMA CONQUIP AB) 23 August 1990, see the whole document --	1-15
A	GB, A, 2112982 (MITSUI ENGINEERING AND SHIPBUILDING CO. LTD.) 27 July 1983, see the whole document --	11-14
A	DE, A1, 3825097 (R. STAHL FÖRDERTECHNIK GMBH) 8 February 1990, see the whole document --	11-14

* Special categories of cited documents:[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
17th July 1992	1992 -07- 27
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	Joakim Grip

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	GB, A, 1470402 (H. JUNGHEINRICH & CO. MASCHINENFABRIK) 14 April 1977, see page 2, line 1 - line 36 --	1-10
X,P	WO, A1, 9114644 (ASEA BROWN BOVERI AB) 3 October 1991, see the whole document --	1-15
X,P	EP, A1, 0440915 (KONE OY) 14 August 1991, see the whole document --	1-10

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.PCT/SE 92/00284

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the Swedish Patent Office EDP file on 29/05/92
The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP-A2- 0342655	89-11-23	DE-A-	3816988	89-11-30
		JP-A-	2018295	90-01-22
		US-A-	5048703	91-09-17
WO-A1- 9009336	90-08-23	NONE		
GB-A- 2112982	83-07-27	DE-A-C-	3240320	83-05-19
		JP-A-	58077615	83-05-11
		JP-A-	58077616	83-05-11
DE-A1- 3825097	90-02-08	EP-A-	0352565	90-01-31
		JP-A-	2132096	90-05-21
		US-A-	5023434	91-06-11
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		DE-A-B-C	2308450	74-09-05
		FR-A-B-	2218278	74-09-13
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EP-A1- 0440915	91-08-14	US-A-	5067013	91-11-19